

ATLANTA CONSTITUTION (GA)
11 June 1985

From grocery stores to CIA, lasers come of age

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Lasers scanners tote up the groceries at checkout counters, help the Central Intelligence Agency read the world's newspapers, and trace the outline of Georgia in the night at Stone Mountain.

The laser, 25 years old this spring, can generate beams of light precise and powerful enough to drill holes in diamonds, weld the retina of a human eye into position, or perform microsurgery on individual cells.

Tuned to the right frequency and unleashed at high power, beams of laser light can knock out heat-seeking missiles moving at 2,000 miles an hour. In more benign form, they animate the games in a video arcade.

Since its invention, the laser (which stands for light amplification by stimulated emission of radiation) has beamed its way into medicine, defense, communications and computers, even art and entertainment.

"I can't think of any concept that has had a bigger impact in 25 years," said Dr. James L. Gole, a professor at Georgia Tech's School of Physics, where lasers are used to explore high-temperature physics. "I can't think of any device that is even close. It has opened up many areas that before were impossible to probe."

In May 1960, Dr. Theodore H. Maiman built the world's first laser at Hughes Research Laboratories. With a rod of synthetic ruby, he harnessed light to radiate a high-energy beam of a pure red light.

Maiman's laser excited electrons into emitting photons — the basic unit of light energy — at a single wavelength, then dumped the pure, "coherent" light into an amplified beam as red as the ruby that produced it.

"The laser ranks up there with the vacuum tube, the transistor and the integrated circuit," says Dr. Bernard S. Finn, curator of "The Laser at 25," an exhibit organized by the Smithsonian's National Museum of American History to observe the invention's anniversary. Over the next three years, the exhibit is scheduled to travel to 15 cities, including Huntsville, Ala., in November.

Maiman's first laser generated only red light, but today lasers come in as many different colors as they do shapes and sizes.

The world's most powerful laser — 10 amplifiers, each longer than a football field — fills a large building at the Lawrence Livermore National Laboratory in Liver-

more, Calif. The smallest — a semiconductor 350 microns wide and 250 microns long — is small enough to float on a teardrop.

The Livermore laser, named Nova, took eight years and \$176 million to build. Its predecessor — a carbon dioxide laser called Antares — generated more than 12 trillion watts of radiant energy in a single burst lasting one-billionth of a second. Dedicated last month, Nova will be used in weapons research and to study thermonuclear fusion power.

Tiny semiconductor lasers are the heart of grocery store cash register scanners, sophisticated communications systems, optical radar and a new breed of computer that the day may help orbiting defense systems detect and track incoming missiles.

At Georgia Tech, a team led by Dr. Tom Gaylord is working with scientists from eight universities as part of a \$9 million Star Wars research project aimed at developing a computer that can perform 1,000 simultaneous calculations. Conventional computers can handle only one operation at a time.

Gaylord's group is developing a computer memory that uses a laser to store information as a three-dimensional image in a synthetic crystal. The technique vastly increases available computer memory and provides instant access to it. A conventional computer must sort through its stored data one bit at a time.

To test one element of potential Star Wars technology, scientists in Hawaii later this month will fire a laser beam at a reflector aboard the space shuttle Discovery. Pentagon researchers hope to learn how much the light spreads on its way through the atmosphere and how to correct it, knowledge critical to the construction of a large laser weapon.

Coming down to Earth, laser technology is no farther away than most wallets and pocketbooks. Visa and MasterCard, plagued by counterfeiters, incorporate glittering three-dimensional laser images called holograms into their new credit cards to foil forgers. Each is etched on a thermoplastic square only millionths of an inch thick.

Lasers have worked their way into many facets of society:

As "light scalpels," they have transformed the science of eye surgery. They are also used to cauterize bleeding ulcers, remove tumors, tattoos and birthmarks. Doctors now use lasers to clear clogged arter-

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